HUNTSMAN

Enriching lives through innovation

Advanced Materials

Araldite® LY 3505* / Hardeners XB 3403* / XB 3404* / Aradur® 3405*

WARM CURING EPOXY SYSTEMS

Araldite® LY 3505 is an epoxy resin
Hardeners XB 3403, XB 3404 and Aradur® 3405 are based on aliphatic polyamines

APPLICATIONS

Industrial composites, repair of composites.

PROPERTIES

Laminating systems without reactive diluent. The reactivity of the systems may easily be adjusted to demands through the combination of the three hardeners of different reactivity. The long possible pot life facilitates the production of very large industrial parts. The systems are qualified by Germanischer Lloyd.

PROCESSING

- Wet lay-up
- Filament Winding
- Resin Transfer Moulding (RTM)
- Pressure Moulding

KEY DATA

Araldite® LY 3505		
Aspect (visual)	clear liquid	
Colour (Gardner, ISO 4630)	≤ 3	
Viscosity at 25 °C (ISO 12058-1)	6500 - 8000	[mPa s]
Density at 25 °C (ISO 1675)	1.15 - 1.20	[g/cm^3]
Flash point (ISO 2719)	> 200	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]

Hardener XB 3403		
Aspect (visual)	transparent liquid	
Viscosity at 25 °C (ISO 12058-1)	5 - 20	[mPa s]
Density at 25 °C (ISO 1675)	0.95 - 1.0	[g/cm^3]
Flash point (ISO 2719)	124	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]

Hardener XB 3404		
Aspect (visual)	clear, blue liquid	
Viscosity at 25 °C (ISO 12058-1)	20 - 40	[mPa s]
Density at 25 °C (ISO 1675)	0.95 - 1.0	[g/cm^3]
Flash point (ISO 2719)	121	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]

KEY DATA

Hardener XB 3405		
Aspect (visual)	clear, red liquid	
Viscosity at 25 °C (ISO 12058-1)	70 - 90	[mPa s]
Density at 25 °C (ISO 1675)	0.95 - 1.0	[g/cm^3]
Flash point (ISO 2719)	109	[°C]
Storage temperature (see expiry date on original container)	2 - 40	[°C]

* *In addition to the brand name product denomination may show different appendices , which allows us to differentiate between our production sites: e.g , BD = Germany, US = United States, IN = India, CI = China,etc. These appendices are in use on packaging, transport and invoicing documents. Generally the same specifications apply for all versions. Please address any additional need for clarification to the appropriate Huntsman contact.*

PROCESSING DATA

MIX RATIO

Components	*Parts by weight*	*Parts by volume*
Araldite® LY 3505	100	100
Hardener XB 3403	35	42
Araldite® LY 3505	100	100
Hardener XB 3404	35	42
Araldite® LY 3505	100	100
Hardener XB 3405	35	42

We recommend that the components are weighed with an accurate balance to prevent mixing inaccuracies which can affect the properties of the matrix system. The components should be mixed thoroughly to ensure homogeneity. It is important that the side and the bottom of the vessel are incorporated into the mixing process.

When processing large quantities of mixture the pot life will decrease due to exothermic reaction. It is advisable to divide large mixes into several smaller containers.

INITIAL MIX VISCOSITY

(HOEPPLER, ISO 12058-1)

	[*°C*]	[*mPa s*]
LY 3505/XB 3403	at 25	300 - 400
LY 3505/XB 3404	at 25	550 - 800
LY 3505/XB 3405	at 25	1000 - 1200

POT LIFE

(TECAM, 100 ML, 65 % RH)

	[*°C*]	[*min*]
LY 3505/XB 3403	at 23	600 - 720
	at 30	430 - 510
LY 3505/XB 3404	at 23	80 - 100
LY 3505/XB 3405	at 23	26 - 36

GEL TIME

(HOT PLATE)

	[*°C*]	[*min*]
LY 3505/XB 3403	at 60	105 - 125
	at 80	36 - 48
	at 100	14 - 18
LY 3505/XB 3404	at 60	60 - 70
	at 80	11 - 18
	at 100	3 - 7
LY 3505/XB 3405	at 60	18 - 26
	at 80	5 - 11
	at 100	1 - 6

The values shown are for small amounts of pure resin/hardener mix. In composite structures the gel time can differ significantly from the given values depending on the fibre content and the laminate thickness.

GELATION AT 23 °C

(IN THIN LAYERS: 0.4 - 0.7 MM)

		[*h*]
LY 3505/XB 3403	Start	14 - 16
	End	19 - 21
LY 3505/XB 3404	Start	5 - 7
	End	9 - 11
LY 3505/XB 3405	Start	2 - 3
	End	4 - 5

TYPICAL CURE CYCLES

15 h at 50 °C
or 8 - 10 h at 60 °C
or 6 - 8 h at 80 °C

Optimum properties cannot be reached with room temperature cure.

The optimum cure cycle has to be determined case by case depending on the pro cessing and the economic requirements.

RECOMMENDATIONS TO GET SHORTEST CURING TIME

at 50 °C	with XB 3403 = 10 h	with XB 3404 = 7 h	with XB 3405 = 6 h
at 60 °C	with XB 3403 = 8 h	with XB 3404 = 6 h	with XB 3405 = 4 h

	at 80 °C	with XB 3403 = 6 h	with XB 3404 = 3 h	with XB 3405 = 1 h	

PROPERTIES OF THE CURED, NEAT FORMULATION					
GLASS TRANSITION TEMPERATURE	*Cure:*	T_G	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
(IEC 1006, DSC, 10 K/MIN)	8 days 23 °C	[°C]	49 - 53	48 - 52	55 - 60
	1 day 23 °C + 15 h 50 °C	[°C]	63 - 68	64 - 69	68 - 73
	8 h 60 °C	[°C]	66 - 72	66 - 71	71 - 76
	6 h 80 °C	[°C]	75 - 80	75 - 80	86 - 91
	4 h 60 °C + 6 h 80 °C	[°C]	78 - 83	76 - 81	87 - 92
	8 h 100 °C	[°C]	81 - 86	77 - 82	85 - 89
TENSILE TEST (ISO 527)		*Cure: 4 h 60 °C + 6 h 80 °C*	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
	Tensile strength	[MPa]	70 - 74	82 - 86	85 - 90
	Elongation at tensile strength	[%]	3.8 - 4.2	4.0 - 4.4	4.4 - 4.9
	Ultimate strength	[MPa]	46 - 50	73 - 78	83 - 89
	Ultimate elongation	[%]	10 - 13	5.2 - 5.8	5.0 - 6.2
	Tensile modulus	[MPa]	3180 - 3280	3400 - 3700	3500 - 3900
FLEXURAL TEST (ISO 178)		*Cure: 7 days 23 °C*	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
	Flexural strength	[MPa]	85 - 93	100 - 110	90 - 100
	Elongation at flexural strength	[%]	2.4 - 2.8	3.3 - 4.0	2.2 - 2.6
	Ultimate strength	[MPa]	85 - 93	100 - 110	90 - 100
	Ultimate elongation	[%]	2.4 - 2.8	3.3 - 4.0	2.2 - 2.6
	Flexural modulus	[MPa]	3450 - 3600	3400 - 3550	3800 - 4000
		Cure: 24 h 23 °C + 15 h 50 °C	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
	Flexural strength	[MPa]	120 - 135	135 - 150	140 - 155
	Elongation at flexural strength	[%]	4.4 - 4.8	4.5 - 5.3	5.0 - 6.0
	Ultimate strength	[MPa]	64 - 72	125 - 150	125 - 140
	Ultimate elongation	[%]	11.0 - 13.0	5.5 - 7.5	7.0 - 8.5
	Flexural modulus	[MPa]	3400 - 3550	3550 - 3700	3600 - 3750
		Cure: 4 h 60 °C + 6 h 80 °C	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
	Flexural strength	[MPa]	110 - 130	125 - 145	135 - 155
	Elongation at flexural strength	[%]	4.8 - 5.5	5.0 6.0	5.2 - 6.2
	Ultimate strength	[MPa]	70 - 85	100 - 135	125 - 145
	Ultimate elongation	[%]	10.5 - 13.0	6.5 - 9.5	7.0 - 9.0
	Flexural modulus	[MPa]	3100 - 3300	3450 - 3600	3450 - 3650
FRACTURE PROPERTIES BEND NOTCH TEST (PM 258-0/90)		*Cure: 4 h 60 °C + 6 h 80 °C*	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
	Fracture toughness K_{1C}	[MPa√m]	0.95 - 1.05	0.8 - 0.95	0.8 - 0.9
	Fracture energy G_{1C}	[J/m^2]	250 - 280	160 - 200	150 - 190
WATER ABSORPTION (ISO 62)	*Immersion:*	*Cure: 4 h 60 °C + 6 h 80 °C*	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
	10 days H_2O 23 °C	[%]	0.38 - 0.42	0.25 - 0.30	0.30 - 0.35

PROPERTIES OF THE CURED, REINFORCED FORMULATION

INTERLAMINAR SHEAR STRENGTH (ASTM D 2344)

Short beam: Laminate comprising 12 layers unidirectional E-glass fabric (425 g/m^2)
Laminate thickness t = 3.0 - 3.2 mm
Fibre volume content: 63 - 65 %

	Cure: 4 h 60 °C + 6 h 80 °C	*LY 3505 XB 3403*	*LY 3505 XB 3404*	*LY 3505 XB 3405*
Shear strength	[MPa]	53 - 57	59 - 62	54 - 58

STORAGE

Provided that Araldite LY 3505 and Hardeners XB 3403, XB 3404 and XB 3405 are stored in a dry place in their original, properly closed containers at the above mentioned storage temperatures they will have the shelf lives indicated on the labels. Partly emptied containers should be closed immediately after use.

HANDLING PRECAUTIONS

Personal hygiene

Safety precautions at workplace	
protective clothing	yes
gloves	essential
arm protectors	recommended when skin contact likely
goggles/safety glasses	yes
Skin protection	
before starting work	Apply barrier cream to exposed skin
after washing	Apply barrier or nourishing cream
Cleansing of contaminated skin	
	Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents
Disposal of spillage	
	Soak up with sawdust or cotton waste and deposit in plastic-lined bin
Ventilation	
of workshop	Renew air 3 to 5 times an hour
of workplaces	Exhaust fans. Operatives should avoid inhaling vapours

FIRST AID

Contamination of the *eyes* by resin, hardener or mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted.
Material smeared or splashed on the *skin* should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (see above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately.
Anyone taken ill after *inhaling* vapours should be moved out of doors immediately. In all cases of doubt call for medical assistance.

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